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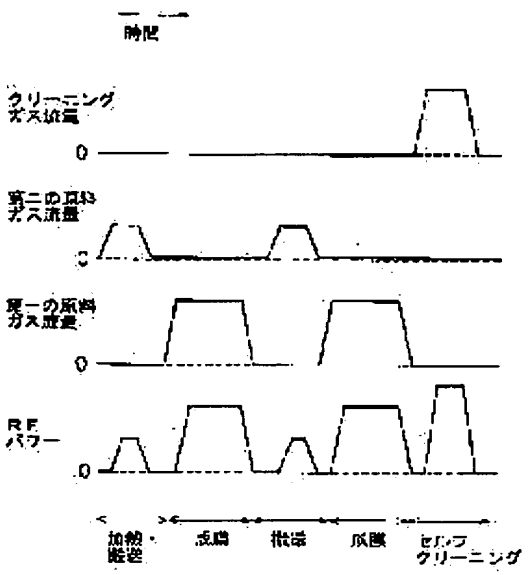
(54) FILM DEPOSITION BY THIN FILM DEPOSITION DEVICE, SELF- CLEANING METHOD AND THIN FILM DEPOSITION DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide film deposition by using a thin film deposition device capable of reducing the time required for self-cleaning and capable of improving the productivity, to provide a self-cleaning method and to provide a thin film deposition device.

SOLUTION: Before the deposition of a desired first film on a member to be film-deposited, the outer face of a member other than the member to be film-deposited and the inner face of the reaction chamber are deposited with second films having an etching rate higher than that of the first film, and after that, the member to be film-deposited is arranged at the inside of the reaction chamber to deposit the first film. Then, the member to be film-deposited is deposited with the first film which is carried out from the reaction chamber, thereafter, gas or radicals having etching properties are introduced into the reaction chamber, the second films and first film deposited in layers at the outer face of the member other than the member to be film-deposited and the inner face of the reaction chamber are removed by etching, and self-cleaning is executed.



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CLAIMS

[Claim(s)]
[Claim 1] Before arranging the above-mentioned member formed membranes in the above-mentioned reaction chamber in the reaction chamber of a vacuum housing, in membrane formation of the thin film deposition system which forms the 1st desired film to the member formed membranes, and the self-cleaning approach in the above-mentioned reaction chamber To the external surface of members other than the member prepared in this reaction chamber formed membranes, and the inside of a reaction chamber The 2nd film with an etch rate higher than the 1st film of the above is formed. After formation of the 2nd film of the above, The above-mentioned member formed membranes is arranged in the above-mentioned reaction chamber. In a list on the above-mentioned member formed membranes After taking out the member which forms the 1st film of the above in the external surface of members other than the above-mentioned member formed membranes, and the inside of a reaction chamber and by which the 1st film of the above was formed in them from the above-mentioned reaction chamber formed membranes, by etching nature gas or the radical Membrane formation of the thin film deposition system characterized by etching and carrying out self-cleaning to the 2nd film and the 1st film which were formed in the external surface of members other than the above-mentioned member formed membranes, and the inside of a reaction chamber, the self-cleaning approach.
[Claim 2] Before arranging the above-mentioned member formed membranes in the above-mentioned reaction chamber in the reaction chamber of a vacuum housing, in membrane formation of the thin film deposition system which forms the 1st desired film to the member formed membranes, and the self-cleaning approach in the above-mentioned reaction chamber To the external surface of members other than the member prepared in this reaction chamber formed membranes, and the inside of a reaction chamber The 2nd film with an etch rate higher than the 1st film of the above is formed. After formation of the 2nd film of the above, The above-mentioned member formed membranes is arranged in the above-mentioned reaction chamber. In a list on the above-mentioned member formed membranes The 1st film of the above is formed in the external surface of members other than the above-mentioned member formed membranes, and the inside of a reaction chamber. After taking out the member in which the 1st film of the above was formed formed membranes from the above-mentioned reaction chamber, by repeating the formation process of the 2nd film of the above, and the formation process of the 1st film of the above to the member formed membranes about the member of the number of requests formed membranes While forming the 1st film of the above on each ****** member, laminating formation of the 2nd film and the 1st film is carried out by turns at the external surface of members other than the above-mentioned member formed membranes, and the inside of a reaction chamber. After taking out the last member formed membranes from the above-mentioned reaction chamber, by etching nature gas or the radical Membrane formation of the thin film deposition system characterized by etching into coincidence the 2nd film and the 1st film by which laminating formation was carried out by turns, and carrying out self-cleaning to the external surface of members other than the above-mentioned member formed membranes, and the inside of a reaction chamber, the self-cleaning approach.
[Claim 3] The membrane formation of a thin film deposition system according to claim 1 or 2 carried out [forming the 2nd film of the above, where the above-mentioned reaction chamber is exhausted to a vacuum, arranging the above-mentioned member formed membranes in a reaction chamber, where the above-mentioned reaction chamber is maintained to a vacuum, forming the 1st film of the above, taking out the above-mentioned member formed membranes from a reaction chamber, where the above-mentioned reaction chamber is maintained to a vacuum and performing the above-mentioned etching and] as the description, the self-cleaning approach.

[Claim 4] Membrane formation of the thin film deposition system according to claim 1 or 2 characterized by forming the 1st film of the above by introducing the 2nd material gas into a reaction chamber where the above-mentioned reaction chamber is exhausted to a vacuum, forming the 2nd film of the above by activating the 2nd material gas of the above, introducing the 1st material gas into a reaction chamber where the above-mentioned reaction chamber is maintained to a vacuum, and activating the 1st material gas, the self-cleaning approach.
[Claim 5] They are membrane formation of the thin film deposition system according to claim 1 or 2 whose 1st film of the above is silicon oxide and whose 2nd film is the amorphous silicon film or a silicon nitride, and the self-cleaning approach.
[Claim 6] The 1st film of the above is membrane formation of the thin film deposition system according to claim 5 characterized by being the silicon oxide formed using the tetra-ethoxy silane, and the self-cleaning approach.
[Claim 7] The vacuum housing equipped with the conveyance room for conveying the reaction chamber divided by the sluice valve, and the member formed membranes, The susceptor in which it is prepared in the above-mentioned reaction chamber, and the above-mentioned member formed membranes is laid, and the gas supply section which introduces material gas in the above-mentioned reaction chamber, Between an activation means to activate the material gas which countered the above-mentioned susceptor, was formed in the above-mentioned reaction chamber, and was introduced from the gas supply section, and to form membranes, and the above-mentioned reaction chamber and a conveyance room The 1st film takes out the member formed [membrane formation ****] membranes from a reaction chamber according to the above-mentioned conveyance device the conveyance device in which the above-mentioned member formed membranes is conveyed, and in the above-mentioned reaction chamber, with a vacua maintained. By the time the following member formed membranes is carried in to the above-mentioned reaction chamber according to the above-mentioned conveyance device The thin film deposition system characterized by providing the control section which closes the above-mentioned sluice valve and forms the 2nd film in the external surface of the above-mentioned susceptor and an activation means, and a list in the above-mentioned reaction chamber with the above-mentioned gas supply section and an activation means at the inside of a reaction chamber.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to membrane formation of the thin film deposition system used for manufacture of electron devices, such as a semiconductor device and a liquid crystal display component, the self-cleaning approach, and a thin film deposition system.
[0002]
[Description of the Prior Art] In recent years, reactant gas is introduced into the vacuum housing beforehand exhausted to the vacuum as a thin film deposition system used for manufacture of electron devices, such as a semiconductor device and a liquid crystal display component, etc., and the thin film deposition system which is made to activate this reactant gas with the plasma or light, and forms a thin film on a substrate is used widely.
[0003] Generally in such a thin film deposition system, a substrate heater, RF electrode (shower plate), etc. with which a substrate is laid are prepared in the reaction chamber in a vacuum housing. Moreover, while the gas inlet for introducing reactant gas and the pressure control valve are prepared in the reaction chamber at the vacuum housing, RF power source is connected to RF electrode. Furthermore, it connects with a load lock chamber through a valve with a reaction chamber end, and the heater, the conveyance device, etc. which a substrate is heated beforehand are prepared in this load lock chamber.
[0004] When the above-mentioned thin film deposition system performs thin film formation, after exhausting a reaction chamber to a vacuum, a substrate is laid on a substrate heater. after the substrate was heated all over the load lock chamber exhausted by the vacuum -- as -- a valve -- minding -- the inside of a vacuum -- a reaction chamber -- conveying -- having . Then, material gas is introduced in a reaction chamber from a gas inlet. In this case, material gas is introduced into homogeneity in a reaction chamber from the pore of a large number prepared in RF electrode surface. And by supplying high-frequency power to RF electrode from RF power source, it discharges in a reaction chamber and the plasma occurs. Material gas is decomposed by the generated plasma, active species generates, and a thin film grows on a substrate.
[0005] In such a thin film deposition system, the film adheres also to RF electrodes and the vacuum vessel-wall sides other than a substrate at the time of thin film formation. If the thickness of the adhering film becomes more than fixed, the film will exfoliate and will generate particle in a reaction chamber. In order to prevent generating of such particle, introduce the gas which contains installation or an etching nature element for the gas of etching nature, it is made to usually discharge in a reaction chamber to the time amount which does not form membranes, an etching nature radical is generated, and self-cleaning which removes the thin film adhering to a vacuum vessel-wall side or RF electrode is performed.
[0006]
[Problem(s) to be Solved by the Invention] In order to raise the productivity of a thin film deposition system, the shorter one of the time amount which the above self-cleanings take is desirable. However, in the film used for a liquid crystal display component and a semiconductor device, compared with the film of others [etching / of the SiOx film], an etch rate is slow, and self-cleaning takes time amount. By SiOx film of high quality which is especially used for the gate dielectric film of the polish recon thin film transistor in a liquid crystal display component, this problem becomes remarkable.
[0007] This invention was made in view of the above point, and even when a quality thin film is formed, that purpose offers and combines the self-cleaning approach of the thin film deposition system which can shorten the time amount which self-cleaning takes, and is to offer the thin film deposition system which was excellent in productivity.
[0008]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, membrane formation of the thin film deposition system concerning this invention, and the self-cleaning approach Before arranging the above-mentioned member formed membranes in the above-mentioned reaction chamber in the reaction chamber of a vacuum housing, in membrane formation of the thin film deposition system which forms the 1st desired film to the member formed membranes, and the self-cleaning approach in the above-mentioned reaction chamber To the external surface of members other than the member prepared in this reaction chamber formed membranes, and the inside of a reaction chamber The 2nd film with an etch rate higher than the 1st film of the above is formed. After formation of the 2nd film of the above, The above-mentioned member formed membranes is arranged in the above-mentioned reaction chamber. In a list on the above-mentioned member formed membranes After taking out the member which forms the 1st film of the above in the external surface of members other than the above-mentioned member formed membranes, and the inside of a reaction chamber and by which the 1st film of the above was formed in them from the above-mentioned reaction chamber formed membranes, by etching nature gas or the radical It is characterized by etching and carrying out self-cleaning to the 2nd film and the 1st film which were formed in the external surface of members other than the above-mentioned member formed membranes, and the inside of a reaction chamber.

[0009] Moreover, membrane formation of the thin film deposition system concerning this invention and the self-cleaning approach Before arranging the above-mentioned member formed membranes in the above-mentioned reaction chamber in the reaction chamber of a vacuum housing, in membrane formation of the thin film deposition system which forms the 1st desired film to the member formed membranes, and the self-cleaning approach in the above-mentioned reaction chamber To the external surface of members other than the member prepared in this reaction chamber formed membranes, and the inside of a reaction chamber The 2nd film with an etch rate higher than the 1st film of the above is formed. After formation of the 2nd film of the above, The above-mentioned member formed membranes is arranged in the above-mentioned reaction chamber. In a list on the above-mentioned member formed membranes The 1st film of the above is formed in the external surface of members other than the above-mentioned member formed membranes, and the inside of a reaction chamber. After taking out the member in which the 1st film of the above was formed formed membranes from the above-mentioned reaction chamber, the formation process of the 2nd film of the above and the formation process of the 1st film of the above to the member formed membranes are repeated about the member of the number of requests formed membranes. While forming the 1st film of the above on each ****** member, laminating formation of the 2nd film and the 1st film is carried out by turns at the external surface of members other than the above-mentioned member formed membranes, and the inside of a reaction chamber. After taking out the last member formed membranes from the above-mentioned reaction chamber, etching nature gas or a radical is introduced in the above-mentioned reaction chamber. It is characterized by etching into coincidence the 2nd film and the 1st film by which laminating formation was carried out by turns, and carrying out self-cleaning to the external surface of members other than the above-mentioned member formed membranes, and the inside of a reaction chamber.

[0010] Furthermore, the vacuum housing equipped with the conveyance room for the thin film deposition system concerning this invention to convey the reaction chamber divided by the sluice valve, and the member formed membranes, The susceptor in which it is prepared in the above-mentioned reaction chamber, and the above-mentioned member formed membranes is laid, and the gas supply section which introduces material gas in the above-mentioned reaction chamber, Between an activation means to activate the material gas which countered the above-mentioned susceptor, was formed in the above-mentioned reaction chamber, and was introduced from the gas supply section, and to form membranes, and the above-mentioned reaction chamber and a conveyance room The 1st film takes out the member formed [membrane formation ****] membranes from a reaction chamber according to the above-mentioned conveyance device the conveyance device in which the above-mentioned member formed membranes is conveyed, and in the above-mentioned reaction chamber, with a vacua maintained. By the time the following member formed membranes is carried in to the above-mentioned reaction chamber according to the above-mentioned conveyance device It is characterized by providing the control section which closes the above-mentioned sluice valve and forms the 2nd film in the external surface of the above-mentioned susceptor and an activation means, and a list in the above-mentioned reaction chamber with the above-mentioned gas supply section and an activation means at the inside of a reaction chamber.

[0011] According to the membrane formation constituted as mentioned above, the self-cleaning approach, and the thin film deposition system, inside, by carrying out laminating formation of the 1st film and the 2nd film with an etch rate higher than this 1st film, inside, the etch rate of the 1st film at the time of self-cleaning

can be gathered to the external surface of members other than the member prepared in the reaction chamber formed membranes, and the inside of a reaction chamber, SENOREFU cleaning time amount can be shortened, and improvement in productivity can be aimed at.

[0012]

[Embodiment of the Invention] Hereafter, the gestalt of implementation of this invention is explained to a detail, referring to a drawing. First, if a thin film deposition system is explained, as shown in drawing 1 , a thin film deposition system is equipped with a vacuum housing 10, and the reaction chamber 12 for performing membrane formation processing to a substrate, the load lock chamber 14 for carrying in and taking out a substrate to a reaction chamber, and ** are specified in this vacuum housing. While the reaction chamber 12 and the load lock chamber 14 are divided by sluice valve 16a, the other end of a load lock chamber 14 is also divided by sluice valve 16b.

[0013] In a reaction chamber 12, the RF electrode (shower plate) 18 which countered the substrate heater 16 and substrate heater which function as susceptor is formed, and a substrate heater heats a substrate while the substrate 20 as a member formed membranes is laid. The pore of a large number which let gas pass is prepared in the substrate heater 16 of the RF electrode 18, and the front face which counters.

[0014] Moreover, the exhaust port 24 which carried out opening is established in the gas inlet 22 for introducing reactant gas to a reaction chamber 12, and the reaction chamber at the vacuum housing 10. While the source 23 of gas supply is connected to the gas inlet 22, the pressure regulating valve 26 which opens and closes this exhaust port is formed in the exhaust port 24. Furthermore, the RF power source 28 is connected to the RF electrode 18. These RF electrode 18 and the RF power source 28 constitute the activation means in this invention.

[0015] In the load lock chamber 14, the conveyance device 30 in which let sluice valve 16a pass, and a substrate 20 is carried in and taken out, the heater 32 for heating a substrate 20 beforehand, and ** are prepared to the reaction chamber 12. As for these conveyance devices 30, a heater 32, the RF power source 28, the source 23 of gas supply, and the substrate heater 16, actuation is controlled by the control section 21.

[0016] Next, the membrane formation process and self KURINGU process by thin film shaping equipment of the above-mentioned configuration are explained. First, in a membrane formation process, before forming the film (the 1st film) of the normal made into the purpose on a substrate 20, the quick auxiliary film (the 2nd film) of an etch rate is formed rather than the 1st film to the external surface of RF electrode 18 grades other than the substrate formed in the reaction chamber 12, or the inside of a reaction chamber 12. Then, the 1st film is formed to a substrate 20 and the 1st film is formed in the 2nd film formed in coincidence at RF electrode 18 external surface or a reaction chamber inside in piles.

[0017] If it states to a detail, as shown in drawing 2 , after exhausting a reaction chamber 12 to a vacuum, the 2nd material gas other than the 1st material gas used for membrane formation of the 1st film will be first supplied into a reaction chamber 12 from a gas inlet 22. And by supplying high-frequency power to the RF electrode 18 from the RF power source 28, and making a reaction chamber 12 generate the plasma, the 2nd supplied material gas is decomposed and the thin film of the 2nd film is carried out to RF electrode 18 external surface or a reaction chamber inside. While forming the 2nd film, a substrate 20 is heated in a load lock chamber 14.

[0018] Then, where the inside of a reaction chamber 12 is maintained to a vacuum, the substrate 20 heated beforehand is carried in into a reaction chamber 12 from a load lock chamber 14 through sluice valve 16a, and it lays on the substrate heater 16.

[0019] Next, the 1st material gas is introduced in a reaction chamber 12 from a gas inlet 22. Under the present circumstances, the 1st material gas is introduced into homogeneity in a reaction chamber from the pore of a large number prepared in RF electrode 18 front face. And by supplying high-frequency power to the RF electrode 18 from the RF power source 28, it discharges in a reaction chamber 12 and the plasma is generated. The 1st material gas is decomposed by this generated plasma, active species generates, and the 1st film of normal is formed on a substrate 20. Under the present circumstances, in RF electrode 18 external surface or a reaction container inside, the 1st film is formed in piles on the 2nd film formed beforehand.

[0020] Subsequently, the substrate 20 with which the 1st film was formed is taken out from a reaction chamber 12, and another substrate is carried in to the reaction chamber 12 of a vacuum housing 10. And time amount after taking out of this substrate 20 is completed until the following substrate is carried in is used, and the 2nd film is formed according to the same process as the above to RF electrode external surface in a reaction chamber 12, a reaction chamber inside, etc. Then, the following substrate 20 is carried in in a reaction chamber 12, and the 1st film is formed.

[0021] By repeating the process mentioned above by the number of sheets of a substrate, and performing it, the 1st film is formed by each substrate, and with the external surface of members other than the substrate formed in the reaction chamber 12, or the inside of a reaction chamber, the 2nd film and the 1st film lap by turns, and are formed.
[0022] And after taking out the last substrate from a vacuum housing 10, self-cleaning of a thin film deposition system is performed. That is, the 1st and 2nd film by which laminating formation was carried out is etched and removed to RF electrode 18 external surface, reaction chamber 12 inside, etc. by introducing the gas or the radical of etching nature into a reaction chamber 12 from a gas inlet 22, and supplying high-frequency power to the RF electrode 18 from the RF power source 28, without breaking the vacua after taking out of a substrate 20 and in a reaction chamber 12. Thereby, self-cleaning of the inside of a reaction chamber 12 is carried out.
[0023] As an example, to TEOS, the mixed gas of 1:50, O2, and RF power, to the 1st film at the silicon oxidation (SiOx) film and the 1st material gas by 0.8 W/cm2 The 1st film of 150nm thickness per membrane formation is formed. As SiH4 and RF power to the amorphous silicon (a-Si) film and the 2nd material gas as the 2nd film by 0.1 W/cm2 After forming the 2nd film of 20nm thickness with membrane formation at once and repeating the membrane formation process of these 1st and 2nd film by six substrates, self-cleaning was performed by RF power 1.0 W/cm2, using the mixed gas of NF3 and Ar1:2 as gas of etching nature.
[0024] Consequently, to the time amount which self-cleaning takes having been 8 minutes by the conventional approach, according to this example, it is for 5 minutes, and self-cleaning time amount was shortened sharply. Moreover, in order to perform formation of the 2nd film during conveyance of a substrate, the effectiveness of the whole membrane formation process does not fall by membrane formation of the 2nd film.
[0025] Thus, according to the thin film deposition system of the above-mentioned configuration and membrane formation, and the self-cleaning approach By forming the 2nd film with an etch rate quicker than this 1st film between membrane formation at the external surface and reaction chamber insides of a member other than the substrate in which it was prepared in the reaction chamber, before forming the 1st film of normal on the substrate as a member formed membranes As compared with the case of only the 1st film, the etch rate of the 1st film at the time of self-cleaning can be gathered, and self-cleaning time amount can be shortened. Consequently, the processing effectiveness of a thin film deposition system can improve, and productivity can be raised.
[0026] In addition, this invention is variously deformable within the limits of this invention, without being limited to the gestalt of operation mentioned above. For example, although the gas of another kind was completely used with the 1st material gas as the 2nd material gas with the gestalt of the above-mentioned implementation, since the same effectiveness will be acquired if the film with an etch rate higher than the 1st film is formed as the 2nd film, it is also possible by choosing conditions appropriately by methods of changing a mixing ratio, such as changing only a pressure and changing RF power, to use material gas of the same kind.
[0027] Moreover, with the gestalt of operation mentioned above, when processing two or more substrates continuously, the 2nd film is formed before membrane formation of each substrate, but when the 2nd film was formed only at 1 time before membrane formation of the substrate of the beginning after self-cleaning, or even when the 2nd film is formed for every two or more substrates, the same operation effectiveness as the gestalt of the above-mentioned implementation can be acquired.
[0028]
[Effect of the Invention] As explained in full detail above, according to this invention, even when a quality thin film is formed, the time amount which self-cleaning takes can be shortened, and the membrane formation of a thin film deposition system which can aim at improvement in productivity, the self-cleaning approach, and a thin film deposition system can be offered.

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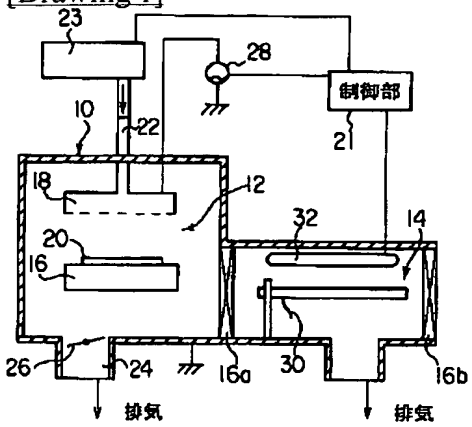
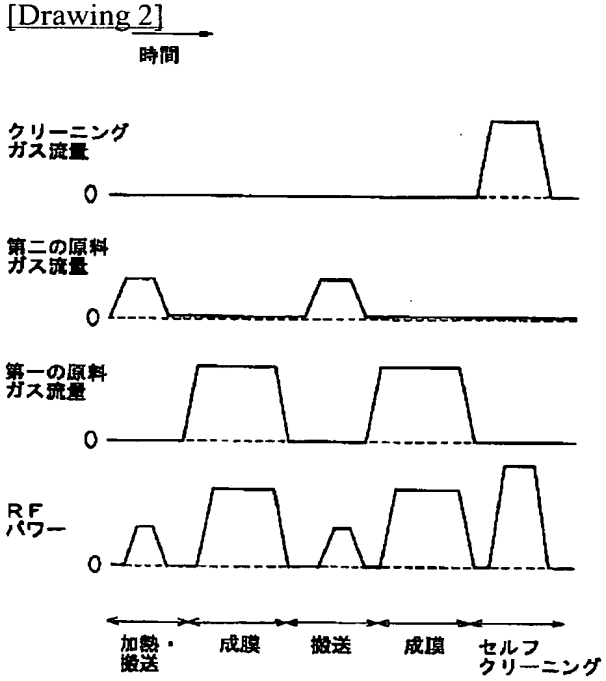
DRAWINGS

[Drawing 1]



[Drawing 2]



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16/40		16/40		５Ｆ００４
Ｈ０１Ｌ 21/3065		Ｈ０１Ｌ 21/31	Ｃ	５Ｆ０４５
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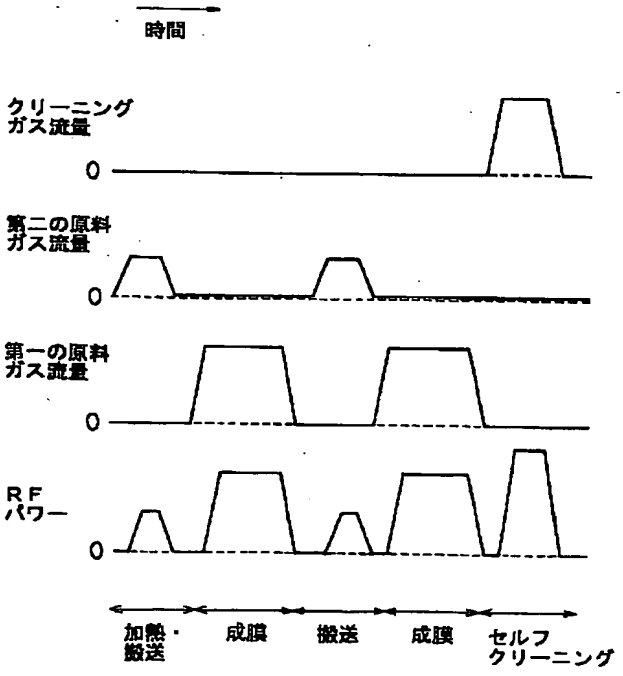
最終頁に続く

(54)【発明の名称】　薄膜形成装置の成膜、セルフクリーニング方法および薄膜形成装置

(57)【要約】
【課題】セルフクリーニングに要する時間を短縮でき、生産性の向上を図ることができる薄膜形成装置の成膜、セルフクリーニング方法、および薄膜形成装置を提供する

【解決手段】被成膜部材に所望の第１膜を形成する前に、薄膜形成装置の反応室内に設けられた被成膜部材以外の部材の外面および反応室の内面に、第１膜よりもエッチング速度の高い第２膜を形成した後、反応室内に被成膜部材を配置し、第１膜を形成する。そして、第１膜の形成された被成膜部材を反応室から搬出した後、反応室内にエッチング性のガスまたはラジカルを導入し、被成膜部材以外の部材の外面および反応室の内面に積層形成された第２膜および第１膜をエッチングにより除去し、セルフクリーニングを行う。



【特許請求の範囲】

【請求項１】真空容器の反応室内で被成膜部材に所望の第１膜を成膜する薄膜形成装置の成膜、セルフクリーニング方法において、

上記反応室内に上記被成膜部材を配置する前に、上記反応室内で、この反応室内に設けられた被成膜部材以外の部材の外面および反応室の内面に、上記第１膜よりもエッチング速度の高い第２膜を形成し、

上記第２膜の形成後、上記反応室内に上記被成膜部材を配置し、上記被成膜部材上、並びに、上記被成膜部材以外の部材の外面および反応室の内面に、上記第１膜を形成し、

上記反応室から上記第１膜の形成された被成膜部材を搬出した後、エッチング性ガスまたはラジカルにより、上記被成膜部材以外の部材の外面および反応室の内面に形成された第２膜および第１膜にエッチングしてセルフクリーニングすることを特徴とする薄膜形成装置の成膜、セルフクリーニング方法。

【請求項２】真空容器の反応室内で被成膜部材に所望の第１膜を成膜する薄膜形成装置の成膜、セルフクリーニング方法において、

上記反応室内に上記被成膜部材を配置する前に、上記反応室内で、この反応室内に設けられた被成膜部材以外の部材の外面および反応室の内面に、上記第１膜よりもエッチング速度の高い第２膜を形成し、

上記第２膜の形成後、上記反応室内に上記被成膜部材を配置し、上記被成膜部材上、並びに、上記被成膜部材以外の部材の外面および反応室の内面に、上記第１膜を形成し、

上記第１膜の形成された被成膜部材を上記反応室から搬出した後、上記第２膜の形成工程と被成膜部材に対する上記第１膜の形成工程とを所望数の被成膜部材について繰り返すことにより、各被成膜部材上に上記第１膜を形成するとともに、上記被成膜部材以外の部材の外面および反応室の内面に第２膜および第１膜を交互に積層形成し、

最後の被成膜部材を上記反応室から搬出した後、エッチング性ガスまたはラジカルにより、上記被成膜部材以外の部材の外面および反応室の内面に交互に積層形成された第２膜および第１膜を同時にエッチングしてセルフクリーニングすることを特徴とする薄膜形成装置の成膜、セルフクリーニング方法。

【請求項３】上記反応室を真空に排気した状態で上記第２膜を形成し、上記反応室を真空に維持した状態で反応室内に上記被成膜部材を配置して上記第１膜を形成し、上記反応室を真空に維持した状態で反応室から上記被成膜部材を搬出し上記エッチングを行うことを特徴とする請求項１又は２に記載の薄膜形成装置の成膜、セルフクリーニング方法。

【請求項４】上記反応室を真空に排気した状態で反応室に第２原料ガスを導入し、上記第２原料ガスを活性化することにより上記第２膜を形成し、

上記反応室を真空に維持した状態で反応室に第１原料ガスを導入し、第１原料ガスを活性化することにより上記第１膜を形成することを特徴とする請求項１又は２に記載の薄膜形成装置の成膜、セルフクリーニング方法。

【請求項５】上記第１膜はシリコン酸化膜、第２膜はアモルファスシリコン膜もしくはシリコン窒化膜である請求項１又は２に記載の薄膜形成装置の成膜、セルフクリーニング方法。

【請求項６】上記第１膜は、テトラエトキシシランを用いて成膜されたシリコン酸化膜であることを特徴とする請求項５に記載の薄膜形成装置の成膜、セルフクリーニング方法。

【請求項７】仕切弁により仕切られた反応室と被成膜部材を搬送するための搬送室とを備えた真空容器と、

上記反応室に設けられ上記被成膜部材が載置される支持台と、

上記反応室内に原料ガスを導入するガス供給部と、

上記支持台に対向して上記反応室内に設けられ、ガス供給部から導入された原料ガスを活性化して成膜する活性化手段と、

上記反応室と搬送室との間で、真空状態を維持したまま、上記被成膜部材を搬送する搬送機構と、

上記反応室内で第１膜が成膜れた被成膜部材を上記搬送機構によって反応室から搬出し、上記搬送機構により次の被成膜部材が上記反応室に搬入されるまでの間に、上記仕切弁を閉じ上記ガス供給部および活性化手段により上記反応室内で上記支持台および活性化手段の外面、並びに反応室の内面に第２膜を成膜する制御部と、

を具備したことを特徴とする薄膜形成装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、半導体素子や液晶表示素子等の電子デバイスの製造に用いられる薄膜形成装置の成膜、セルフクリーニング方法、および薄膜形成装置に関する。

【０００２】

【従来の技術】近年、半導体素子や液晶表示素子等の電子デバイス等の製造に用いられる薄膜形成装置として、予め真空に排気した真空容器に反応性ガスを導入し、この反応性ガスをプラズマや光で活性化させて基板上に薄膜を形成する薄膜形成装置が広く用いられている。

【０００３】このような薄膜形成装置では、一般に、真空容器内の反応室には、基板が載置される基板ヒータ、ＲＦ電極(シャワープレート)等が設けられている。また、真空容器には、反応室へ反応性ガスを導入するためのガス導入口、圧力調整バルブが設けられているとともに、ＲＦ電極にはＲＦ電源が接続されている。更に、反応室はしきり弁を介してロードロック室に接続され、

のロードロック室には、基板を予め加熱するヒータ、搬送機構等が設けられている。

【０００４】上記薄膜形成装置により薄膜形成を行う場合、反応室を真空に排気した後、基板ヒータ上に基板を載置する。基板は、真空に排気されたロードロック室中で加熱された後、しきり弁を介して真空中で反応室に搬送される。続いて、ガス導入口から原料ガスを反応室内に導入する。この場合、原料ガスは、ＲＦ電極表面に設けられた多数の細孔から均一に反応室に導入される。そして、ＲＦ電源からＲＦ電極に高周波電力を供給することにより、反応室内で放電しプラズマが発生する。発生したプラズマにより原料ガスが分解され、活性種が生成して基板上に薄膜が成長する。

【０００５】このような薄膜形成装置においては、薄膜形成時、基板以外のＲＦ電極や真空容器壁面にも膜が付着する。付着した膜の厚さが一定以上になると、膜は剥離し反応室内にパーティクルを発生させる。このようなパーティクルの発生を防止するため、通常、成膜を行わない時間に反応室内にエッチング性のガスを導入、もしくはエッチング性元素を含むガスを導入し、放電させてエッチング性ラジカルを発生させ、真空容器壁面やＲＦ電極に付着した薄膜を除去するセルフクリーニングが行われる。

【０００６】

【発明が解決しようとする課題】薄膜形成装置の生産性を上げるためには、上記のようなセルフクリーニングに要する時間は短い方が望ましい。しかしながら、液晶表示素子や、半導体素子に用いられる膜の中では、ＳｉＯｘ膜のエッチングが他の膜に比べてエッチング速度が遅く、セルフクリーニングに時間が掛かる。特に、液晶表示素子におけるポリシリコン薄膜トランジスタのゲート絶縁膜に用いられるような高品質のＳｉＯｘ膜では、この問題が顕著となる。

【０００７】この発明は以上の点に鑑みなされたもので、その目的は、高品質な薄膜を形成した場合でもセルフクリーニングに要する時間を短縮できる薄膜形成装置のセルフクリーニング方法を提供し、併せて、生産性の優れた薄膜形成装置を提供することにある。

【０００８】

【課題を解決するための手段】上記目的を達成するため、この発明に係る薄膜形成装置の成膜、セルフクリーニング方法は、真空容器の反応室内で被成膜部材に所望の第１膜を成膜する薄膜形成装置の成膜、セルフクリーニング方法において、上記反応室内に上記被成膜部材を配置する前に、上記反応室内で、この反応室内に設けられた被成膜部材以外の部材の外面および反応室の内面に、上記第１膜よりもエッチング速度の高い第２膜を形成し、上記第２膜の形成後、上記反応室内に上記被成膜部材を配置し、上記被成膜部材上、並びに、上記被成膜部材以外の部材の外面および反応室の内面に、上記第１膜を形成し、上記反応室から上記第１膜の形成された被成膜部材を搬出した後、エッチング性ガスまたはラジカルにより、上記被成膜部材以外の部材の外面および反応室の内面に形成された第２膜および第１膜にエッチングしてセルフクリーニングすることを特徴としている。

【０００９】また、この発明に係る薄膜形成装置の成膜、セルフクリーニング方法は、真空容器の反応室内で被成膜部材に所望の第１膜を成膜する薄膜形成装置の成膜、セルフクリーニング方法において、上記反応室内に上記被成膜部材を配置する前に、上記反応室内で、この反応室内に設けられた被成膜部材以外の部材の外面および反応室の内面に、上記第１膜よりもエッチング速度の高い第２膜を形成し、上記第２膜の形成後、上記反応室内に上記被成膜部材を配置し、上記被成膜部材上、並びに、上記被成膜部材以外の部材の外面および反応室の内面に、上記第１膜を形成し、上記第１膜の形成された被成膜部材を上記反応室から搬出した後、上記第２膜の形成工程と被成膜部材に対する上記第１膜の形成工程とを所望数の被成膜部材について繰り返し、各被成膜部材上に上記第１膜を形成するとともに、上記被成膜部材以外の部材の外面および反応室の内面に第２膜および第１膜を交互に積層形成し、最後の被成膜部材を上記反応室から搬出した後、上記反応室内にエッチング性ガスまたはラジカルを導入し、上記被成膜部材以外の部材の外面および反応室の内面に交互に積層形成された第２膜および第１膜を同時にエッチングしてセルフクリーニングすることを特徴としている。

【００１０】更に、この発明に係る薄膜形成装置は、仕切弁により仕切られた反応室と被成膜部材を搬送するための搬送室とを備えた真空容器と、上記反応室に設けられ上記被成膜部材が載置される支持台と、上記反応室内に原料ガスを導入するガス供給部と、上記支持台に対向して上記反応室内に設けられ、ガス供給部から導入された原料ガスを活性化して成膜する活性化手段と、上記反応室と搬送室との間で、真空状態を維持したまま、上記被成膜部材を搬送する搬送機構と、上記反応室内で第１膜が成膜れた被成膜部材を上記搬送機構によって反応室から搬出し、上記搬送機構により次の被成膜部材が上記反応室に搬入されるまでの間に、上記仕切弁を閉じ上記ガス供給部および活性化手段により上記反応室内で上記支持台および活性化手段の外面、並びに反応室の内面に第２膜を成膜する制御部と、を具備したことを特徴としている。

【００１１】上記のように構成された成膜、セルフクリーニング方法、および薄膜形成装置によれば、反応室内に設けられた被成膜部材以外の部材の外面および反応室の内面に、第１膜およびこの第１膜よりもエッチング速度の高い第２膜を積層形成することにより、セルフクリーニング時の第１膜のエッチング速度を上げることができ、セノレフクリーニング時間を短縮し生産性の向上

図ることができる。

【００１２】

【発明の実施の形態】以下、図面を参照しながら、この発明の実施の形態について詳細に説明する。まず、薄膜形成装置について説明すると、図１に示すように、薄膜形成装置は真空容器１０を備え、この真空容器内には、基板に対して成膜処理を行うための反応室１２と、反応室に対して基板を搬入および搬出するためのロードロック室１４と、が規定されている。反応室１２とロードロック室１４とは仕切弁１６ａによって仕切られているとともに、ロードロック室１４の他端も仕切弁１６ｂによって仕切られている。

【００１３】反応室１２内には、支持台として機能する基板ヒータ１６および基板ヒータに対向したＲＦ電極（シャワープレート）１８が設けられ、基板ヒータは、被成膜部材としての基板２０が載置されるとともに基板を加熱する。ＲＦ電極１８の基板ヒータ１６と対向する表面には、ガスを通す多数の細孔が設けられている。

【００１４】また、真空容器１０には、反応室１２へ反応性ガスを導入するためのガス導入口２２、および反応室に開口した排気口２４が設けられている。ガス導入口２２には、ガス供給源２３が接続されているとともに、排気口２４には、この排気口を開閉する圧力調整弁２６が設けられている。更に、ＲＦ電極１８にはＲＦ電源２８が接続されている。これらＲＦ電極１８およびＲＦ電源２８は、この発明における活性化手段を構成している。

【００１５】ロードロック室１４内には、反応室１２に対し、仕切弁１６ａを通して基板２０を搬入および搬出する搬送機構３０と、基板２０を予め加熱するためのヒータ３２と、が設けられている。これらの搬送機構３０、ヒータ３２、ＲＦ電源２８、ガス供給源２３、および基板ヒータ１６は、制御部２１によって動作が制御される。

【００１６】次に、上記構成の薄膜成形装置による成膜工程およびセルフクリーング工程について説明する。まず、成膜工程においては、基板２０上に目的とする正規の膜（第１膜）を形成する前に、反応室１２内に設けられている基板以外のＲＦ電極１８等の外面や反応室１２の内面に、第１膜よりもエッチング速度の速い補助膜（第２膜）を成膜する。その後、基板２０に対して第１膜の成膜を行い、同時に、ＲＦ電極１８外面や反応室内面に形成された第２膜に重ねて第１膜を形成する。

【００１７】詳細に述べると、図２に示すように、まず、反応室１２を真空に排気した後、第１膜の成膜に用いる第１原料ガスとは別の第２原料ガスをガス導入口２２から反応室１２内へ供給する。そして、ＲＦ電源２８からＲＦ電極１８に高周波電力を供給し反応室１２にプラズマを発生させることにより、供給された第２原料ガスを分解してＲＦ電極１８外面や反応室内面に、第２膜を薄膜する。第２膜を成膜している間、基板２０はロードロック室１４内で加熱される。

【００１８】続いて、反応室１２内を真空に維持した状態で、仕切弁１６ａを介して、予め加熱された基板２０をロードロック室１４から反応室１２内へ搬入し、基板ヒータ１６上に載置する。

【００１９】次に、ガス導入口２２から第１原料ガスを反応室１２内に導入する。この際、第１原料ガスは、ＲＦ電極１８表面に設けられた多数の細孔から反応室に均一に導入される。そして、ＲＦ電源２８からＲＦ電極１８に高周波電力を供給することにより、反応室１２内で放電しプラズマを発生させる。この発生したプラズマにより第１原料ガスが分解され、活性種が生成して基板２０上に正規の第１膜が成膜される。この際、ＲＦ電極１８外面や反応容器内面において、予め形成された第２膜上に第１膜が重ねて成膜される。

【００２０】次いで、第１膜の形成された基板２０を反応室１２から搬出し、別の基板を真空容器１０の反応室１２に搬入する。そして、この基板２０の搬出が終了してから次の基板が搬入されるまでの時間を利用し、上記と同様の工程により、反応室１２内のＲＦ電極外面、反応室内面等に第２膜を成膜する。その後、次の基板２０を反応室１２内に搬入し、第１膜の成膜を行う。

【００２１】上述した工程を基板の枚数分だけ繰り返し行うことにより、各基板には第１膜が成膜され、反応室１２内に設けられた基板以外の部材の外面や反応室の内面には、第２膜と第１膜とが交互に重なって成膜される。

【００２２】そして、最後の基板を真空容器１０から搬出した後、薄膜形成装置のセルフクリーニングを行う。すなわち、基板２０の搬出後、反応室１２内の真空状態を破ることなく、ガス導入口２２から反応室１２内へエッチング性のガスあるいはラジカルを導入し、ＲＦ電源２８からＲＦ電極１８に高周波電力を供給することにより、ＲＦ電極１８外面、反応室１２内面等に積層形成された第１および第２膜をエッチングし除去する。これにより、反応室１２内がセルフクリーニングされる。

【００２３】実施例として、第１膜にシリコン酸化（ＳｉＯｘ）膜、第１原料ガスにＴＥＯＳとO_2との１：５０の混合ガス、ＲＦパワーに０．８Ｗ／ｃｍ^{2}で、１回の成膜につき１５０ｎｍ厚の第１膜を成膜し、また、第２膜としてアモルファスシリコン（ａ－Ｓｉ）膜、第２原料ガスにＳｉH_4、ＲＦパワーとして０．１Ｗ／ｃｍ^{2}で、１回に成膜つき２０ｎｍ厚の第２膜を成膜し、これら第１および第２膜の成膜工程を６枚の基板分繰り返した後、エッチング性のガスとしてＮF_3とＡｒとの１：２の混合ガスを用い、ＲＦパワー１．０Ｗ／ｃｍ^{2}でセルフクリーニングを行った。

【００２４】その結果、セルフクリーニングに要する時間は、従来の方法では８分であったのに対して、本実

例によれば５分間であり、セルフクリーニング時間が大幅に短縮された。また、第２膜の形成は、基板の搬送中に行うため、第２膜の成膜によって、成膜工程全体の効率が落ちることもない。

【００２５】このように、上記構成の薄膜形成装置および成膜、セルフクリーニング方法によれば、被成膜部材としての基板上に正規の第１膜を形成する前、および成膜間に、この第１膜よりもエッチング速度の速い第２膜を反応室内に設けられた基板以外の部材の外面や反応室内面に形成することにより、第１膜のみの場合に比較して、セルフクリーニング時の第１膜のエッチング速度を上げることができ、セルフクリーニング時間を短縮することができる。その結果、薄膜形成装置の処理効率が向上し、生産性を上げることができる。

【００２６】なお、この発明は上述した実施の形態に限定されることなく、この発明の範囲内で種々変形可能である。例えば、上記実施の形態では、第２原料ガスとして、第１原料ガスと全く別種のガスを用いたが、第２膜として第１膜よりもエッチング速度の高い膜を成膜すれば同様の効果が得られるため、混合比を変える、圧力のみを変える、ＲＦパワーを変える等の方法で条件を適切に選択することにより、同種の原料ガスを使用することも可能である。

【００２７】また、上述した実施の形態では、複数の基板を連続して処理する場合に各基板の成膜前に第２膜の成膜を行っているが、セルフクリーニング後の最初の基板の成膜前の１度のみに第２膜の成膜を行った場合や、基板複数枚毎に第２膜を成膜した場合でも、上記実施の形態と同様の作用効果を得ることができる。

【００２８】

【発明の効果】以上詳述したように、この発明によれば、高品質な薄膜を形成した場合でもセルフクリーニングに要する時間を短縮でき、生産性の向上を図ることができる薄膜形成装置の成膜、セルフクリーニング方法、および薄膜形成装置を提供することができる。

【図面の簡単な説明】

【図１】この発明に係る薄膜形成装置を示す断面図。

【図２】上記薄膜形成装置による成膜工程およびセルフクリーニング工程におけるタイミングチャート。

【符号の説明】

１０…真空容器

１２…反応室

１４…ロードロック室

１６…基板ヒータ

１８…ＲＦ電極

２０…基板

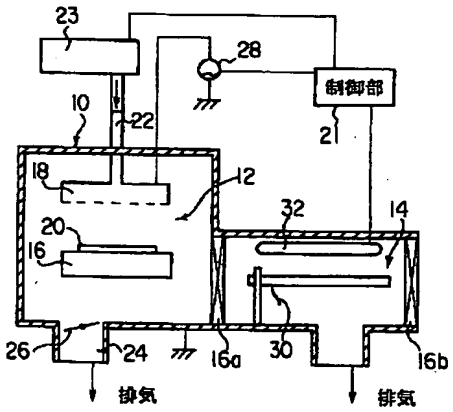
２１…制御部

２２…ガス導入口

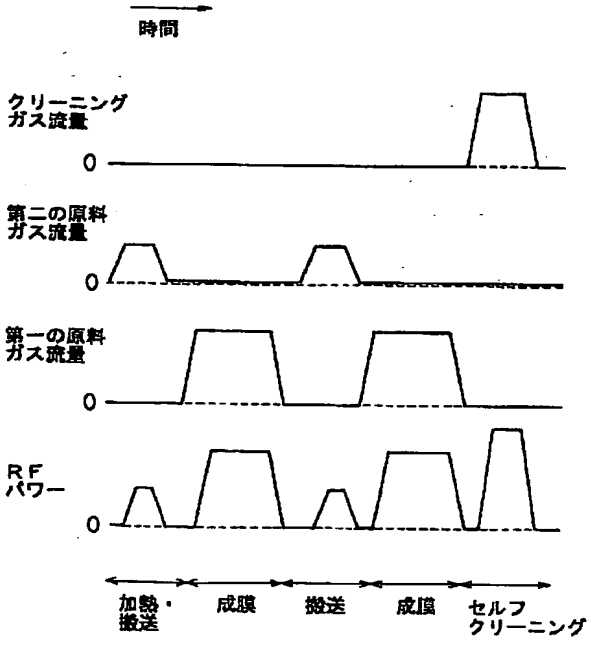
２３…ガス供給源

２８…ＲＦ電源

【図１】



【図２】



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